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The present period of the history of railroads seem to be distinguished in a remarkable degree by the general discussion of the economical relations of the system. This is owing partly to the universal stagnation of business in its usual channels—partly to the cessation of construction on most works and the natural diversion of the attention of professional men to this particular subject—and partly to the efforts of those companies who, wishing either to commence or complete their works, are urging their claims individually and those of railroads generally, upon the attention of capitalists.

That the proper discussion of this subject is of the greatest importance, no one doubts. Mere empty assertion or even careless investigation of facts, is not only useless but positively injurious. Discerning men have therefore directed their attention to the collection of strict and authentic statistics, and also to the rigorous analysis of the information already collected, with a view to its application to future undertakings. Although a great improvement has already been made in the form according to which railroad statistics are published, there remains much to be done before the documents shall possess that clearness and distinctness of detail upon which all strict and rigorous calculation must be based. In the proper place we shall endeavor to point out these desiderata. Meanwhile it may not be curious to remark that imperfect as these data may be, they still contain nearly if not quite all the items, although not properly separated and distinguished—and from these we may derive

tolerably correct approximations to the cost of railroad management, even somewhat in detail.

Our object at present is to give an outline of the errors and difficulties which have operated injuriously upon some railroads—and to make an abstract of the information derived from well established lines, with a view to determine as nearly as possible the cost of management.

In doing this no claim is made to infallibility—nor is any reflection intended upon those who entertain different views. It is only from the comparison of opposite opinions that the truth can in most cases be arrived at, and improper warmth in criticising the opinions of others, as well as over sensitiveness in bearing the examination of our own—are alike unfavorable to fair discussion.

The errors which have produced such unfortunate results in some public works, have commenced at the very outset, and were probably contained in the very germ of the enterprise, we shall therefore consider, in the first place,

Errors in Location.—These have been generally committed by those who have conceived the project—and not unfrequently before professional advice has been taken. In the enthusiasm with which public works are undertaken certain plans are frequently laid which are improperly considered as identical with the work itself, and urged with such feeling that when it is discovered that they are inexpedient, it is too late to abandon them. The conceits of a railroad with so many miles in one straight line—of a tunnel under this hill, or a bridge over that river, or the imposing entrance into this or that part of a town, having once turned the heads of a whole district, are apt to end in emptying their pockets. That these are not mere pictures of fancy, every one knows who has been familiar with the commencement of such works—we need not allude to particular cases, as every one's experience will supply enough of them.

A more culpable error of location, is that in which the terminus of the road, or its intermediate points are placed with distinct reference to private interest, and in direct opposition to the general interests of the company. These most mischievous mis-locations have been so common and glaring as almost to have passed into a byeword. Paper cities to be built up and new avenues to be opened, and a host of similar projects have generally resulted in serious loss to companies. We would not however wish to include in this censure, those locations where no natural or other difficulty existed, and the general interest has been consulted—even though certain

individuals may have procured such a line as might result in their benefit *as* individuals. The endeavor should be to accommodate the greatest number without compromising the company.

Under this same head we might mention those instances in which the whole work has been undertaken as a matter of sheer speculation. Most of our abortive or unsuccessful railroads came under this class—but they are no more to be adduced as examples of railroads, than the South Sea bubble as an instance of legitimate commerce.

Other errors of location are those which are exclusively the fault of the engineer, and these are by far the least both in number and importance. There are not many cases in which such mistakes have been detected, and many which are supposed to exist turn upon disputed professional points. Some of the earliest locations have been re-examined. But these are hardly fair cases, for so little was then known as to the capability of locomotives, that we may consider that under existing circumstances the best was done that could have been done.

Before dismissing this branch of our subject, we will allude to a difficulty often encountered in the commencement of a railroad project—we mean the interference of persons ignorant not only of matters exclusively professional but very often of the principle of what is called common sense. Every engineer must recollect some director or stockholder who imagined himself quite an engineer—and whose ignorance might generally be measured by his conceit. Such men have been so often encountered and so often described, that we need say no more of them. We might however safely say, that these and other evils of a like nature cannot be avoided until the profession of engineering in this country stands upon the same basis and organization with the other professions.

TO ENGINEERS, DIRECTORS AND STOCKHOLDERS OF RAILROADS.

The commencement of the session of Congress renders it necessary that all those whe feel an interest in railroads should bestir themselves to obtain a repeal of that portion of the tariff bill passed in August last, which relates to railroad iron.

At the time of the passage of that bill, no attempts were made to obtain an alteration until it was too late, and in fact few persons had any idea that such a strange restriction would become a law.

The arguments on this question need not now be given in detail; they are briefly these.

Under existing circumstances no railroad iron can be imported with the duty—the law in fact amounts to a prohibition.

No railroad iron can be made in this country at as low a price as it can be imported, even with the duty. No orders can then be expected for home manufacture.

The result will then be that neither railroads now in construction nor those projected can be built at these high prices for iron.

The demand having ceased no iron will be rolled in this country, and as not any of the more complicated patterns have been rolled, in regard to experience in manufacture, things will remain as they now are.

The consequent fall of price in England will draw orders until the maximum is again reached.

But how shall we do without railroads—how are our iron mines to be approached, or our coal—what is to become of the large orders for railroad castings—which were more proffitable to our iron masters than rolled iron ever can be?

The evidences against this restriction for the present at least, are so strong that we need dwell no longer upon them. We may however remark in conclusion, that the importation of locomotive engines ceased and the exportation commenced under the free law. No one can feel more interest in the protection of our iron trade than we do—but the present law in relation to railroad iron is rather for destruction than preservation.

The following memorial has been sent to us, and although late in in the date we wish to urge upon all our readers the necessity of pressing it with all their might. As soon as a few subscribers are obtained it may be forwarded to the member of Congress for the district petitioning.

To the Senate and House of Representatives of the United States, in Congress assembled.

The undersigned would respectfully represent to your honorable body, that owing to a succession of untoward events incident to season, distance, unavoidable delays in the execution of orders, etc. etc., instances exist where railroad iron now imported and intended *to be laid down on railroads* before the 3d of March next, will not, in consequence of circumstances above alluded to, be able to reach that position entitling it, under existing laws, to exemption from duty—and the imposition of a duty of *twenty-five dollars per ton* will

fall peculiarly hard on parties already sorely oppressed by the onerous undertaking of constructing roads at a period of peculiar embarrassment. Some of which roads being in an unfinished state, and awaiting the return of a better condition of pecuniary affairs, must, with the money already expended in surveys, grading and superstructure, become a complete and total loss, if subjected to an additional burthen.

The iron now most approved in the construction of railroads, is of a description that requires much time and labor in making, and will not probably for many years to come be manufactured in this country. To secure such iron, your memorialists, interested in the construction of railroads, have been induced to send their orders to England, where alone such description of iron is as yet exclusively made. Some of these orders were executed under the law of 1832, which authorized exemption from duty if laid down within 3 years after its importation; other orders were executed under the law of 11th Sept. 1841, which law confined the *exemption* to iron imported before 3d March, 1843, and for roads *then* under construction at the passage of said last mentioned act, and "for such iron as was necessary to complete said roads," evidently thus intending not to confine the exemption to the fact that it should be *laid down* before 3d March, 1843, but that it should be *imported* before that period.

The unexpected passage of the Tariff Act of August, 1842, essentially altered the act of 11th Sept. previous, and now renders it necessary that the iron should not only be *imported* before 3d March next, but *laid down* permanently for use before that period; the consequence of which will be to expose some portions of iron to a heavy and unexpected duty, which iron will be found impracticable to be laid down before 3d March, 1843. Under this state of things your memorialists would respectfully urge on your honorable body so far to alter and modify the act of 30th August, 1842, as to authorize an extension of time to three years, within which iron, imported for railroads, shall be laid down on any railroad or inclined plane, provided said iron be necessary to complete such railroads as were commenced before 11th Sept. 1841.

Your memorialists would also respectfully represent to your honorable body the vast importance of railroads to the best interests of the country, and although it may be said that the interest of our own iron mines would be promoted by the imposition of a heavy duty on imported railroad iron, yet it is capable of demonstration, that owing to the peculiar localities of our iron regions, it is first

highly important, for their own interest, that accessibility should be controled as far as practicable, and under the least burthens and obstructions, as one of the indispensable means of rendering our iron mines valuable or available; and as it will require years, and vast capital, to construct works capable of manufacturing the Heavy Edge or H rail, which is now most approved for durability and strength, the question is, Whether it would not be nationally beneficial to allow this description of iron to be imported as under the law of 1832, for a period of three or five years, leaving the *flat bar*, which is capable of being made here with facility, subject to existing duty?

Your memorialists are not unfriendly to the iron interest of the United States, but they can see no injury to that interest by the modification of the act of August, 1842, as set forth in this memorial.

And your memorialists as in duty bound, will ever pray, etc.

The following remarks upon the annual railroad table published in our Journal, are attached to a copy of that table appended to the report of the select committee of Board of Aldermen, upon the New York and Albany Railroad.

The practical deductions from this table are so much to the purpose that we trust our readers will refer back to it while reading this paper.

REMARKS RELATIVE TO THE RECEIPTS, EXPENSES AND DIVIDENDS ON RAILWAYS IN MASSACHUSETTS AND NEW YORK.

It will be perceived, by a table from the Railroad Journal, that the railway *system*, as a *whole*, has been eminently successful in Massachusetts, and that the Boston and Lowell, a freight railroad, for the bulky article of cotton, and its produce manufactured, has paid the largest dividends, to wit: The average of $7\frac{3}{5}$ per cent. per annum for five years.

It will be noted, that the income from passengers, on this road, advanced from $117,642 in the year 1837, to $145,953, a fraction under 5 per cent. per annum; while the freight was increased during the same period from $63,137 to $121,588, or at the rate of 19 per cent. per annum. The increase in the item of freight on the extension of this road to Nashua, is in a much greater ratio —to wit: from $18,406 to 56,764 in three years; increase in freight equal to 70 per cent. per annum; and this too over a short road of

14 miles, that is now further extended, and opened to Concord, in New Hampshire.

The receipts and expenses on three of the principal roads for five years (although too short for economy in their management, and built at a great cost compared with present prices,) should satisfy any person, that an investment in railway shares—"*judiciously located and constructed*, between *desirable points*," must be an investment equal to profitable real estate. This view is now taken in England, as will be perceived by the following extract from the Bankers' Circular of the 6th Feb. 1841:

"Regarded as property of permanent investment for income, and not merely as speculative things, to be bandied from hand to hand on the faith of names and exaggerated representations, we have a higher confidence in railway shares generally, than we had when we wrote two years ago on the subject. Therefore, viewed as valuable annuities, investments in the leading lines must be considered safe. We are giving no opinion of the present marketable value of shares that may be more or less than the annuity is worth, but merely asserting that the system is so far in advance of the experimental stage in which, on former occasions, we considered it, as to warrant the description, that it has worked out a *valuable property;* which, as such, may now be set down as *being permanently established.*"

It will be perceived by the table, that nine railroads in Massachusetts, radiating from Boston, and in length 392 miles, cost up to Jan 1, 1842, the sum of $16,300,937

The receipts on these roads from 2 to 5 years since their completion, is

From passengers	$3,525,804	
From freight	1,816,422	
		$5,342,226

The receipts on the Western Railroad, from Worcester to Albany, 157 miles, for the last ten months, up to the 1st October, 1842, is $424,010. As the receipts for passengers and freight have steadily increased, and in the month of October had reached $59,141, it is therefore safe to estimate the gross receipts on this road at above half a million of dollars for the year 1842, with an insufficient number of locomotive engines and freight-cars. This $500,000 is exclusive of the earnings on the Boston and Worcester Railroad of 44 miles, which for 1841 was $310,807. This year the re-

ceipts will exceed $400,000, or say $900,000 for 201 miles of road.

That our capitalists have been unfortunate in their first investments, in *short* and *experimental* railroads, in and near this city, injudiciously located and constructed, is to be regretted.

It can in part be accounted for, and every candid inquirer after truth will discover, that every railroad in England and in this country, on *long lines*, between places of business or thoroughfares, have been eminently successful. Our capitalists have suffered in the following pioneer railroads, from their not being well considered, and costing too much. On the *Long Island Railroad*, via. Jamaica towards Greenport, there is to be a direct competition with steamboats on the Sound, which is open nearly the whole year: on its completion it will no doubt do a fair and remunerating business. The *Stonington railroad* runs near and parallel to water, open nearly the whole season, with no country to support it. The *New Jersey Railroad*, with accidents from flood and fire, has entered into a successful competition with steamboats from N. Brunswick to New York, at very reduced fares, and this, too, even with the expenditure of a large capital in the construction of 34 miles of road. One item is the enormous sum of $352,727, paid for land, damages, depots, and *right of way*.

The *Harlem Railroad Company* has expended large sums on a tunnel, rock excavation, etc., on a short road, with few persons residing at its terminus. It has $1,600,000 invested in 12 miles of road. The *Patterson Railroad* is a short road, with a limited population on its line up to a small manufacturing village; on its extension it will be profitable. The *Catskill Railroad* was only partially completed into the mountains, and failed for want of means to complete it. The *Hudson and Berkshire* has very severe grades, but this road is expected to recover itself and pay dividends. The roads from Albany and Troy, built for *summer travel to Saratoga*, will prove failures, until they are extended to Whitehall. This avenue to Canada will certainly pay dividends. Other roads in which our capitalists have embarked partake more or less of the difficulties enumerated. In fact, we have to look beyond our own city and the Hudson river for successful investments in railroads. We find this to be the case on all the railroads west of Schenectady to Rochester and Batavia. The several roads on this line are now earning 6 to 12 per cent. and even the *Hudson and Mohawk Railroad* has earned 6 to 7 per cent. per annum, on an expenditure of $1,100,000 per 15¼ miles of road, operated by horse and steam power, with the expenses of two inclined planes.

The *Utica and Schenectady Railroad* has yielded, on an expenditure of $1,900,000, in 5 years and 5 months, the sum of	$2,010,979
The whole amount of expenses during the same period, besides paying for the purchase of the Mohawk Turnpike, building 22 miles of road for turnouts, and paying severe taxes, was	707,964
Nett receipts in 5 years and 5 months	$1,309,285

These remarks could be enlarged, by citing several instances of well managed railroads at the South, where the freight of cotton and *bulky* articles are among the principal items of revenue. We will, however, conclude by noticing the *Camden and Amboy Railroad.* By an *official* report from the company, it is shown that this road has earned its entire cost in seven years. It has, however, had to divide its earnings with the Deleware and Raritan Canal, with steamboats and wharves at its two extremes, costing $2,829,797,—on which it had to pay dividends, as well as to its own stockholders, on a capital of $2,291,802, expended on the canal, and in steamboats, wharves, real estate, and coal lands, $929,055. The canal, in fact, earning only five-eights of one per cent.

The gross receipts over the Camden and Amboy Railroad, from 1st Jan. 1833, to 31st Dec. 1839, was	$4,637,535
The gross expenditures during this period,	2,253,993
Nett receipts in seven years,	$2,383,542

Being more than the cost of the railroad; and this too with but limited accommodations for the transportation of freight, at high charges proportioned to other railroads.

TABLE, SHOWING THE LENGTHS OF RAILWAYS RADIATING FROM AND IN CONNECTION WITH THE CITY OF BOSTON.

From Boston, via Albany, to Buffalo		518 miles.
Do.	Portsmouth, to Portland, Maine	104 "
Do.	Lowell, Nashua, and Concord	62 "
Do.	to Providence, Rhode Island	41 "
From Providence to Stonington		47 "

Branch from Andover to Haverhill	25½ "
Dedham Branch	2 "
Taunton Branch, and extension to New Bedford	35 "
Bedford and Fall River	13 "
Norwich and Worcester	58½ "
New Haven to Hartford, 36, and extension to Springfield, 24 miles, not completed	60 "
West Stockbridge to Bridgeport	98 "
West Stockbridge to Hudson	33 "
Troy and Schenectady	22 "
Troy to Ballston	20 "
Schenectady and Saratoga	21½ "
Lockport, Niagara Falls, and Buffalo	43 "
Miles,	1,203½

Note.—The connection of the New York and Albany Railroad with the above web of railways at or near Ghent, in Columbia county, with a distance of only 119 miles from the Harlem river will render available to the city of New York—at all seasons—an expenditure of about *thirty millions of dollars*, on 1,203 miles of railways, now connected with Boston. The city of New York has but 12 miles completed from the City Hall, in connection with the interior.

The report of Mr. Johnson will be read with pleasure by those interested in the great work which he has in charge. From it we find that $300,000 dollars subscribed in New York City will enable this company to furnish by means of intercommunications a continuous railroad to Albany, until the means shall have been provided for a *direct* one.

REPORT ON THE NEW YORK AND ALBANY RAILROAD, ETC.

JONA. J. CODDINGTON, ESQ.
Prest. N. Y. & A. R. Co.:

SIR,—In examining the map of the country through which the New York and Albany Railroad passes, it will be seen that at the distance of about seventy miles from New York city, in the town of Dover, the line of the railroad approaches within about six miles of the Housatonic railroad, at a point where there is an *open valley* between the two.

The Housatonic railroad above this point must, in the event of the

completion of the New York and Albany railroad, become an important branch to the latter road, in bringing to it the business of the western portions of Connecticut and Massachusetts, which will thereby be enabled to reach the city of New York in nearly thirty miles less distance than by the way of Bridgeport, and will avoid the navigation of fifty-eight miles of Long Island Sound, a transshipment at Bridgeport, and about forty-five miles of an inferior railroad.

It will be an object to the New York and Albany Railroad Company to effect the connection of the two roads so soon as their road is completed to Dover; and when this connection is formed, a *continuous* line of railroad will exist from New York to Albany and Troy by the way of the Massachusetts and Albany and West Stockbridge railroads, etc.

This route will serve to accommodate the travel between New York, Albany and Troy, until such time as the New York and Albany road shall be completed on the *direct* route within the limits of the state, which it is reasonable to suppose will not be long delayed after the connection named is formed; for the citizens of New York will not, it is imagined, be long satisfied with the use of an inferior railroad, located upon a route which passes into two other states, over a more elevated summit, is fifteen miles longer in distance, and forty to sixty miles of it under the control of a rival corporation interested in diverting the trade of the North and West to a rival city.

The object of making this communication is to call your attention more particularly to the fact, that when the New York and Albany railroad is completed to Dover, it will come into *immediate and profitable* use as a portion of a *continuous* line of railroad extending to Boston on the East, to Buffalo on the West, and North to Saratoga Springs.

It will also constitute the main trunk from which a branch of three and a half miles (if the cheapest and most direct route for the main line is adopted) will unite by a ferry across the Hudson river with the New York and Erie road at Piermont, and thus bring the travel, etc., which that road may furnish over about fourteen miles of the New York and Albany railroad.

It will also constitute the main trunk for a branch eight and one half miles, extending to Danbury in Connecticut, which there is every reason to believe will be constructed as soon as the main road shall be completed up to the point of junction.

From Danbury there will remain only about thirty miles of distance to unite at New Haven with the line of railway extending thence to Boston, Portland, and other towns, and thus bring the whole of the Eastern travel by the *best* route for a continuous line of railroad to New York city, over nearly forty miles of the New York and Albany railroad.

There is not probably in the whole 3000 miles of railroad now in operation in the United States, an extent of 62 miles of road which presents so many advantages and inducements to capitalists

as the portion of the New York and Albany railroad from New York city to Dover.

At one extreme it terminates in the heart of a growing city, with 350,000 inhabitants. Through its entire length the country is rich and populous, and will have important branches connecting with it on either side.

At the northern terminus, it will connect with a line of railroad stretching 300 miles to the east, 100 miles to the north, and 400 miles to the west. The town of Dover, and the region of country in the vicinity embracing Amenia, North-east, Salisbury, etc., in addition to the rich agricultural resources, is not excelled in the abundance of its mineral treasures of iron and marble combined, by any other equal extent of country in the United States.

The face of the country along the route of the railroad from New York to Dover, is unusually favorable for the cheap construction of the road, and for cheap and rapid transportation. The line from Dover to the city has an average inclination of seven to nine feet only per mile, descending for 50 miles in the direction of the preponderance in the trade, and is very straight, with maximum grades not exceeding thirty feet per mile, and allowing of any desirable speed.

The probable cost of this portion of the road from Harlem river to Dover, if the most direct route is adopted, will not, from the knowledge derived from work already done under existing contracts, exceed the following:

Road bed complete, 62 miles, single track, at $6,400 per mile,		$396,800 00
Superstructure, single track		496,000 00
Land, fencing, and engineering		132,200 00
		1,025,000 00
Add for engines, cars, car houses, etc.		70,000 00
Total		$1,095,000 00
To complete the road bed, and pay for land, fences, and engineering, the amount is $396,800 and 132,200		$529,000 00
Deduct from this one third cost of road bed, to be paid in stock to contractors		132,267 00
		$396,733 00
Deduct available subscriptions in Pawlings, Dover, and Patterson		70,733 00
Remains		$326,000 00
If means are provided to insure the immediate grading of the road to Dover, the subscriptions along the line of the road will be increased, I believe, to the amount of		60,000 00
		$266,000 00

Leaving to be provided for by subscriptions in New York city to complete the road bed and pay all expenses of land and fencing, the sum of $266,00.

When the road bed is complete in all respects, and the right of way obtained, no great difficulty will, it is believed, be experienced in securing, by loan or otherwise, the means for laying down the superstructure, which for a substantial iron rail, (and none other should be used,) will cost as estimated about 8000 dollars per mile, or for the the distance of 62 miles 496,000 dollars.

Assuming as estimated above, that the 62 miles of railroad will cost 1,095,000 dollars, the amount to be divided annually among the stockholders, in order to give them seven per cent. is $75,650 00

The expense of transportation, when of a mixed character, including passengers and freight, according to the experience on other roads, may amount with the repairs of road, to 40 per cent. of gross receipts, or 51,100 00

Giving for the *gross receipts* per annum, in order to realize 7 per cent. the sum of $127,750 00

To produce this amount, if the revenue be supposed to be derived from passengers *alone*, and if *two cents* per mile, or *one dollar and a quarter* only, is charged for each passenger passing the whole distance of 62 miles, it will require 102,200 passages both ways, or 51,100 each way per annum, giving per day 140 each way, or as many only each way per day as can be conveyed in *two* eight wheel passenger cars.

The probability is, that at no season will the number of passengers be less than this, and the average will be so much greater, that the receipts, including what is derived from freight, will afford a surplus, after making seven per cent. dividends upon the capital, sufficient to complete the remainder of the road to Albany in a few years, without greatly adding to the subscriptions.

Respectfully submitted:

E. F. Johnson,
Ch. Eng'r N. Y. & A. R. R. Co.

New York, Nov. 15, 1842.

Patent Office, Nov. 1, 1842.

Having noticed in the public prints an entire misapprehension of the late act of Congress respecting the Patent Office, I hasten to say,

1. That the new law does not alter the fee or duration of patents for such objects as have been hitherto patentable; the amount of which is still thirty dollars, and the term fourteen years. The new law extends protection to a new class of cases, viz. Designs embracing patterns for silk, woolen, and cotton fabrics, for busts,

statue, or bas relief, or composition in alto or basso relievo; such protection having been granted by foreign countries, and not till the present law by the United States.

2. The new law extends the privilege of renewal of lost patents to all those granted before the fire of December, 1836; the former law limiting it to those actually *lost* before the fire; thus excluding many lost subsequent to the fire, and before recording new, leaving the inventor remediless.

3. American Ministers, Consuls, etc., residing abroad, are now authorised to administer oaths to inventors. By the former law such functionaries were not permitted to perform this act; thus subjecting inventors to great inconvenience.

4. The Secretary of the Treasury is now authorized to repay money paid into the Treasury for the Patent Office by mistake; thus precluding the necessity of making special applications to Congress for relief.

5. The new law forbids under a penalty stamping the word PATENT on articles vended where no patent has been obtained, and compels patentees to stamp on the articles vended by them the date of the patent; thus affording the public information of the duration of the patent.

☞Editors of papers or periodicals will render a public service by giving the above an insertion, as the subject matter is interesting to a large portion of the community.

HENRY L. ELLSWORTH,
Commissioner of Patents.

ENGINEER DEPARTMENT, CENTRAL RAILROAD.

SAVANNAH, NOVEMBER 7TH, 1842.

To R. R. Cuyler Esq., President.

SIR—A recurrence of the period at which a report from this department has usually been made, affords me the gratification of addressing to you, the following statement of the condition and progress of the railroad.

The grading of the line is now complete, with the exception of portions of Sections 54, 57, 58, 62, 63, 66 and 69, amounting in all to a distance of about four miles. The track has been laid, and the road completed to Station No. 15. (West of the Oconee river and 152 miles from this city,) and a further distance equal to five miles of finished superstructure has been done, leaving not more than 33 miles to be laid to reach the terminating Depot at Macon.

Timber has been furnished and delivered along the road for the

superstructure, to a point within 14 miles of Macon, and the remainder will probably be supplied by the end of the present year.

We have on hand a sufficient quantity of iron, to reach within 16 miles of Macon; the remainder required to complete the road has been ordered, and is expected to arrive before the end of February: should this expectation be realized, we shall avoid the duty of $25 per ton, imposed by the late Tariff Act, which goes into effect on that article on the 1st of March next.

The Bridge, Trestle work and Embankment, across the river Oconee, and its extensive swamp, has at length been so far completed, as to permit the regular transit of our trains. The work remaining to be done at this point, is confined to the main bridge over the river; and consists of the covering, roof, and a pier of stone in the channel—the bridge being at present supported by a temporary work of timber, founded on large piles driven in the bottom of the river, of ample strength to give perfect safety to the structure until the masonry is completed.

The contractor is at present actively engaged in building a coffer dam, for the purpose of laying the foundation of the pier, and expects to accomplish it before the end of the present year. The stone for the pier has been procured, and delivered on the spot. It is granite, of an excellent quality, and was quarried about 4 miles below Milledgeville, and carried down the Oconee in boats.

The Bridge over the river is 266 feet in length, and is elevated about 30 above ordinary low water. It is constructed on the lattice plan, in two spans, and will be covered so as to be protected from the weather. The trestle bridge, which carries the road for about $2\frac{1}{2}$ miles over the river swamp, is of an average height of 17 feet. It is a frame work of great strength, no timber being less than 12 inches square, and supported by piles driven firmly in the ground. The remainder of the swamp is passed on on embankment at the west end of the trestle bridge, of an average height of 16 feet, and makes in all a distance of about three miles between the high lands on each side of the swamp. This has been a work of great tediousness, in consequence of the unhealthiness of the location in the Summer and Autumn months, and the frequent freshets in the Oconee, during the first twelve months of its progress. It is about two years since it was put under contract. We have had, during the past Summer, almost universal prevalence of fever among our operatives on that part of the line; indeed, it has been a season of unusual unhealthiness, throughout nearly the whole district of country traversed by the road. Every person attached to this department with a single exception, has had an attack of fever, and several of the assistants are still scarcely able to perform their duties.

An arrangement has recently been made with two of our most responsible contractors, which will, if carried out, effect the completion of the road in time for our trains to run through in July next; and I can see no reason why we shall not be prepared to open the business of the next season, at the Depot in Macon.

It is confidently expected also, that the superstructure of the Monroe railroad, which is now laid only to Griffin, (61 miles from Macon,) will be extended to the Western and Atlantic road at White-hall, (101 miles,) and that the State road will be in operation fifty-two miles. Making in all a distance of *three hundred and forty three miles of continuous railroad from the city of Savannah*, by the 4th of July next. Should these expectations be realized, our citizens will at least be gratified with the reflection, that they are not behind their neighbors in "*the grand march of internal improvement.*" It is quite unnecessary for me to speak of the advantages, which, a connexion with the valley of the Tennessee by the railroads now in progress will confer on this Company, and on the city; the subject has during the past Summer, been constantly presented to our citizens, and there are very few of them who are not familiar with it.

Preparations are now being made at Macon, to put up the requisite buildings at the Depot, and they will be arranged with a view to the heavy business that may be expected to flow to the road, on its reaching that point.

The grading of the road, for about 14 miles of the western end of the line, comprehends a succession of heavy cuttings and embankments, with frequent curvitures. This is rendered unavoidable, by the uneven surface of the country, and of course involves a heavier expense, than the average cost of grading the other parts of the line. The heaviest and most costly portions of this work, are completed.

The embankments have mostly been constructed by the use of horses and carts, and the material in all cases being of a character perfectly suitable to the purpose, they possess great solidity. I have adopted the plan of planting their sides with "Bermuda grass," which affords an effectual protection against washing by rains. All the culverts and drains of this portion of the line, have been built of stone, which we have been able to obtain within a few miles of the road.

The troublesome and vexatious business of obtaining conveyances of the requisite lands, and right of way for the road, has been accomplished for nearly the whole route, There are very few cases remaining unsettled, and I do not apprehend any serious difficulty in arranging them.

The feeling of opposition to, and prejudice against the enterprize which prevailed throughout a considerable portion of the country traversed by the road, is gradually subsiding, and I am confident, that as its benefits become more generally extended and felt, it will be regarded with general favor and approbation.

The business of the road since the opening of the fall season, shows a great improvement on that of last year. Cotton is flowing in upon us in great quantities, and the prospect of a profitable winter's work is very encouraging. Our present equipment of motive power is the same as the last year, with the addition of 10 eight wheel burthen cars, nearly ready to put on the track.

We could with our present number of Engines and Cars, bring in about 12,000 bags of Cotton per month, should that quantity offer; we have thus far kept the road clear, or so near it, as never to have had more than two days work accumulate; and I apprehend we shall have no difficulty in doing so during the balance of the season.

In compliance with the general desire of the citizens, and a large portion of the Stockholders of the Company, a reduction has been made in our rates of freight, compared with the tariff of last year. Whether the measure will result in increased profits to the Company or the reverse, remains to be tested. The public appear to be satisfied with the present arrangement.

The total Receipts for the year ending 31st October, are as follows,

For Freight, - - -	$91,456,31	
" Passengers, - - -	30,167,00	
" For transportation of U. S. Mails,	11,912,00	133,535,31
The Current expenses have been as follows,		
For Maintenance of way,	$28,377,47	
" Conducting transportation, including salaries of Agents, Conductors, Clerks, Laborers and various contingent expenses,	21,269,55	
For maintenance of Motive power, repairs of Cars, Engines, etc. including rebuilding the Engines Georgia and Tennessee,	15,188,58	
Fuel and water for Engines,	4,810,80	
Oil and tallow for Engines and Cars,	1,107,79	70,754,19
Leaving a nett profit of		62,781.12
To this amount may be added		
Transportation of materials for the construction of the road,		10,000,00
Actual nett earnings of the road,		72,781,12

This sum, if applied to the capital expended in the construction of the portion of the road in actual use, amounts to about 5 1-2 per cent.

The distance performed by all the Engines during the year, is as follows, Atlantic 21,065, Oconee 19,792, Macon 17,129, Savannah 17,941, John Bolton 9,818, Oglethorpe 8,469, Tennessee 3,723, George 3,509. Total miles run 102,145. The quantity of fuel used in performing this service is, 1358 cords, or an average of one cord for every 75 21-100 miles run.

The aggregate amount of the expenses of working and keeping in repair, the road and machinery, with the transportation expenses, being as before stated, $70,754,19, gives us the rate of 69 26-100 cents per mile as the average cost of running a train for the last

year. The investigations of the Chevelier de Gerstner on this subject, show, that the average of all the railroads in the United States, in operation at that time, (1840,) for this item, was about $1,00 per mile. It should be borne in mind that a much larger business might be done on our road, without a corresponding increase of expense. The present number of superintendants, agents, clerks, etc. would not be materially increased, if the business were doubled.

It is proper to remark in relation to the maintenance of way however, that we have not yet felt the full expense of renewing decayed parts, for more than half of our line. The average cost per mile, for this branch of our expenses, has been about $200 for the last year, on the part of the road in operation. We may expect, that whenever the wooden superstructure reaches the maximum of decay, the expense will be double this amount. We find no difficulty in making contracts with persons along the line, for the supply of timber for keeping the superstructure in repair, on favorable terms; and in all cases where it can be done at a reasonable cost, we are substituting cypress timber, for the pine which was used in the original construction, as the latter decays. My observation on the subject of the decay of timber in our road, has led me to the conclusion, that the renewals of decayed parts will be equivalent to an entire reconstruction of the wooden portion of the road, once in six years.

There has been much written and said on the subject of preparing the timber by the use of mineral substances, so that it may resist the ordinary causes of decay; and many experiments are in progress, in various parts of the country, to test the efficiency of the several modes proposed to effect this most desirable object.

The plan which appears to find most favor in England, where it has been very extensively adopted, is the process of saturating the timber with a solution of corrosive sublimate, termed "Kyanzing." There have however, been various other modes proposed, which if found successful will be much less expensive, and better adapted to the circumstances of the public works in this country. Among these, the process employed by Dr. Earle of Philadelphia, appears to have taken the lead. He uses, instead of corrosive sublimate, a combination of the sulphates of Iron and Copper. Public opinion appears to be much divided on the merits of this "process." My impression is, that so far as our own work is concerned, the best policy is, to await the result of the experiments that are being made, on a very extensive scale on the Western and Atlantic road in our own state, and to a considerable extent on the roads of a neighboring state. The abundance of excellent timber throughout the whole district of country traversed by our road, confirms me as to the propriety of such a course.

The subject of "maintenance of way," is one of the most important of all the matters connected with the management of a railway.

It is a great error to suppose it the best policy, to cut down the expenses of repairs of road to the lowest possible sum that will keep

the road in operation. A proper investigation of the subject, will in most cases, show that an over-strained economy in this branch, will result in constant derangement of machinery, involving increased expenses in the mechanical department, more than equivalent to the apparent saving. To this may be added the vexatious delays of passenger and mail trains, resulting from trifling accidents to the machinery.

From the best information I have on this subject, in relation to the railroads in the southern states, it appears, the force required to maintain the roads, is an average of about one man to a mile, while we have for a distance of 147 miles only 60 men; we must therefore, as the wood work advances in decay, look forward to this number being doubled at least.

There are no means so effectual in regulating and controling the expenditures of a railway as a system by which each item of the multitudinous expenses may at any time be exactly known, and each individual in the service of the company, be at all times made accountable for the particular branch of outlay under his charge, from a spike to a Locomotive Engine.

It is difficult to perfect such a system while the work is in an unfinished state, but we have endeavored to approach as near as possible to it, and in another year, every branch of the service will be brought under systematic regulations.

The following is a list of the persons in the service of the company, on the part of the road in operation.

Transportation Department.		
Superintendent,	1	
Agents,	7	
Clerks,	4	
Conductors,	8	
Laborers,	21	—36
Road Department.		
Road Master,	1	
Carpenters,	9	
Laborers,	50	—60
Mechanical Department.		
Principal Machinist,	1	
Master Carpenter,	1	
Finishers,	3	
Engine Men,	5	
Apprentices,	3	
Smiths,	2	
Strikers,	2	
Fire Men,	5	
Jobbers,	2	
Carpenters,	5	
Pattern Maker,	1	—30
Total,		126

It is intended to provide an ample supply of Engines and Cars in anticipation of the probable amount of business that may offer, during the next Season, when the road shall have been extended to its terminus.

Our present Engines are what are termed the *third class*, that is, they are of the lightest description usually made at the manufactories where they were obtained. Their maximum nett load at ordinary speed on our road is about 65 tons or 350 bales of cotton of medium weight. It will be necessary to have Engines of greater power, when a further number is ordered, and I feel confident that among the several improvements that have been made recently, with a view of increasing the power without adding materially to the weight on each driving wheel, we shall be able to select such as will draw at least twice the burthen of our present ones, without materially increasing the stress on the road.

In conclusion, I think I can with confidence congratulate the stockholders, and the citizens, on the favorable aspect of our enterprize; and its obvious beneficial effect on the business and prosperity of our city in particular. I think we may venture to say, that there is not a city south of the Potomac, which has, during the unprecedented pressure of the times for the last two years, shown so decided indications of improvement as Savannah; there has been a greater number of buildings erected during that time, than for the same period in many years—our population is rapidly increasing, while that of neighboring cities is declining, and our citizens are animated with the brighest hopes of the future.

It is true, our city and its citizens have taken on themselves heavy burthens for the attainment of this object, but it is equally true that by a little further exercise of the extraordinary patience with which they have borne these burthens, they will reap a full harvest to reward them for their sacrifices and efforts.

I cannot close this communication, without alluding to your lamented predecessor in office whom it pleased Divine Providence to remove from us in the early part of the present year.

The example he has left us, of entire devotion to the duties he had undertaken, his untiring perseverance and inflexible integrity in the performance of them, should be emulated by every person in the service of the company—few will be able to come up to such a standard—none to surpass it.

The steadiness and determination with which he pursued the great object of benefiting his native State, and this city, and promoting their prosperity, ought to give his name a place among the most distinguished of public benefactors. It was an object which was remembered in his latest aspirations to Heaven, but a few moments before he yielded up his spirit to him who gave it.

I am sir,

Very respectfully,

Your ob'dt ser'vt.

L. O. REYNOLDS,

Chief Engineer.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING.

Second course–Lecture 14.—*Working expenses of railways.*—Mr. Vignoles commenced by reminding the class, what he hoped they duly felt, that the great object he had in view during the present course was to consider, in every bearing, the proportion between the cost and expenditure upon any work, as compared with the probable profitable returns. Although this consideration, and that of the good result of any such speculations, might be thought not to come strictly within the duties of an engineer, and until of very late years had been neglected, and, in some striking cases, absolutely repudiated, by eminent men, yet Mr. Vignoles was of opinion that it must ever be kept in view, and should absolutely form a branch of the engineer's study, for he ought to feel that any works he may be called on to construct should not only be such as will reflect credit on him, as a professional man, for design, arrangement and execution, but, as the Professor had often urged, such as, in this commercial country, where private enterprise and speculation attempts and effects so much, will, by their success, prove the accuracy of his judgment, and his capacity, as an adviser, to lead spirited undertakers into future operations of the same kind. In short, that the success of an engineer depends, perhaps, more on the beneficial results of his works to the proprietors, as commercial speculations, than on his own masterly conquest by art over natural difficulties. But the engineer should further look at this subject in a higher point of view, and consider that all unprofitable expenditure is so much waste of the resources of a country, and that, of all professions in society, his is the one most called upon to direct the laying out of large sums on what may truly be considered national objects, for the judicious and beneficial results whereof he is responsible, and consequently, whereon his reputation must ultimately depend. Referring to an expression in a late lecture, the Professor observed, that he by no means intended to represent that it was not necessary in the construction of railways, to reduce the natural undulations of a country to uniform inclinations, but that it was to be maturely considered at what cost such advantage is to be acquired, keeping constantly in view a comparison of this cost with the working expenses of a line more or less perfect. It was the investigation of these *working expenses* that was now to be entered on. In proceeding to do this, Mr. Vignoles observed that he considered it by far the best way to reduce to a mileage not only their gross sum, but also each of the items, these being again subdivided as far as possible. By a "mileage" he understood the result arising from dividing the periodical amount of the expenses by the total number of miles run by locomotive engines *with trains after them.* The Professor insisted that this was the proper way, and gave a number of reasons for his opinion, and for not at all considering the expenses with reference to any proportion they might form of the gross receipts—the two sources of income and expenditure being

perfectly independent of each other; and Mr. Vignoles further thought this mileage comparison was the only one from which correct results could be drawn, and whereby materials and experience might be collected, so as to result in the practical benefit of companies being able, before long, to enter into contracts for most of the items of expenditure at given rates. Some companies had already contracted with each other for the supply of locomotive power, carriages, etc. at a mileage; the maintenance of the way was now almost universally paid for by the lineal mile of rail, and he had no doubt but that, after a little more experience, other of the working expenses of railways would form subjects of such a kind of contract.

Mr. Vignoles then proceeded to enumerate the general heads of these expenses, viz. 1, *locomotive power*, subdivided into drivers' wages, fuel, oil, hemp, etc. ordinary repairs, water and fuel stations, reserve fund; 2, *carriages;* 3 *maintenance of line;* 4, *police;* 5, *conducting traffic and stations;* 6, *rates and taxes;* 7, *Government duty;* 8, *miscellaneous charges;* 9, *management.* These were the proper items, exclusive of interest on loans, which, although to be deducted before a dividend could be made, of course formed no part of the positive working expenses of a railway. The Professor then went into a minute analysis of these several items, as actually disbursed on certain railways of various lengths, and particularly of various gradients, explaining the reasons of excess or of diminution in one or other item on the respective lines, exhibiting also comparative tables, and making many valuable observations upon abtaining the best attention and greatest economy from the servants of a public company, by instituting premiums graduated in proportion to the diminution of annual working expenses.

Locomotive power.—In considering this item, Mr. Vignoles showed, from an average of a number of lines, where the arrangements were properly established, and the railway had been long enough at work to have got all matters systematically arranged, the subdivision per mile per train might be taken as follows—viz. wages, 2*d.*; fuel, 4*d.*; oil, hemp, etc., 1*d.*; making 7*d.* per mile as the mere cost of motion, exclusive of repairs of any kind. This might be considered as applicable to an average of six or eight carriages per train. Heavier trains only came occasionally in the course of the 24 hours, and unless upon lines having exceedingly favorable gradients, auxiliary engines were then applied, the cost and mileage of which being included in the annual accounts, the above rate of calculation would still apply. On railways not having a very considerable traffic, the number of carriages, on the average, were fewer than above stated, and the engine and tender might be fairly taken as constituting half the gross load of each train. The items of wages and oil, hemp, etc. would not materially vary on different lines, except, perhaps, the first, or on short lines with very great traffic, with quarter or half-hour trains, such as the London and Greenwich railway, the Dublin and Kingstown, etc. The fuel would be a variable quantity, but it would rarely exceed 6*d.* Next

must be taken the ordinary repairs, and the Professor stated that in no case was the old adage of "a stitch in time" so applicable as in a constant vigilance and daily inspection and remedy of the smallest defect in locomotive engines. A plentiful stock of engines of the very best materials and workmanship, and an efficient and roomy repairing establishment, though somewhat costly at first, would be found to be the means of keeping down the expense of repairs to a low figure. The amount of this item spread over a year's working appeared to average, on well-regulated lines, about 7*d.* to 8*d.* per mile; some instances had been as low as 6*d.* The expense of water and fuel stations varied fron $\frac{1}{4}d.$ to $\frac{1}{2}d.$ per mile. The reserve fund was an arbitrary charge; Mr. Vignoles assumed that about 10 to 15 per cent. on the ordinary repairs would be sufficient—say $1\frac{1}{2}d.$ Thus it would seem that the total cost of locomotive power ought to be about 15*d.* to 16*d.* per mile per train. In some instances it had been reduced so low as 1*s.*; in others this amount had swelled to 18*d.* and even up to 2*s.*

Mr. Vignoles then analysed the other heads of the working expenses—viz. carriages, which he seemed to consider an expensive item, varying from 4*d.* to 6*d.* per mile per train—say from $\frac{1}{2}d.$ to 1*d.* per carriage per mile, including the various descriptions of vehicles for passenger traffic. The maintenance of the railway varied most remarkably, from 2*d.* per mile per train (which had been the cost on the Dublin and Kingstown railway, and was now even lower, and Mr. Vignoles believed that on the Greenwich railway this was also a small item, since they had replaced their stone blocks by timber supports,) up to 1*s.* per mile per train, which was the cost on several lines; but, on a railway with the upper works properly constructed, he thought that 6*d.* to 8*d.* per mile per train ought to keep a double road in good order, including a reserve or depreciation fund for renewing the iron rails—a contingency that should by no means be lost sight of. The Professor her made a long digression on this item, as to how much of the cost should be assigned to atmospheric causes, and all collateral and contingent circumstances; how much to the mere dislocation of the upper works; and how much to the positive wear and tear of the iron; and pointed out some remarkable instances of saving in maintenance, where the longitudinal timber bearings had been adopted. The charge of police varied from 1*d.* to 6*d.* per mile per train, according to the vigilance exercised; in placing 2*d.* per mile as an average it was to be considered only as an approximation. Conducting the traffic and stations was an item that did not seem to differ much on the various lines; for the passenger department it appeared to be about 5*d.* Local rates and taxes would, of course, vary materially; the poor rate formed a serious charge on all railways; this item was indirectly contingent on the actual profits of the company; it appeared, however, to be seldom less than 3*d.* per mile per train. Government duty had heretofore been computed at $\frac{1}{6}d.$ per passenger per mile—henceforth it was to be calculated at 5 per cent. on the gross receipts for passengers only. This would, of course, make

greater discrepancies; still, as the new duty on the gross was estimated to be eqivalent to the old duty, an account might be obtained if the number of passengers per train were known. Assuming this number to average forty, taking all the railways of the United Kingdom, the Government duty might be estimated at 5*d.* per mile per train. Taking a mean of four or five railways, the miscellaneous expenses were found to be about 2*d.* and the management about 3*d.* per mile per train. Now, to make a summary of all these, which was, however, to be taken generally, and, of course liable to be affected in the details, but was still interesting to be submitted in a popular form, and might be useful as giving a comprehensive view of the system:

Abstract of the average working expenses of a railway per mile per train.

Locomotive power—viz. wages. 2*d.*; fuel, 4*d.*; oil, hemp, etc. 1*d.* ordinary repairs, 7*d* ; water and fuel stations, $\frac{1}{2}$*d.*; reserve fund, 1$\frac{1}{2}$*d.*	1 4
Carriages,	0 4
Maintenance of line,	0 8
Police,	0 2
Conducting traffic and stations,	0 5
Local rates and taxes,	0 3
Government duty on passengers,	0 5
Miscellaneous expenses,	0 2
Management,	0 3
Total,	4 0

Mr. Vignoles did not, by any means, pretend that this was other than a probable approximation. Some lines had been worked at a lower rate per mile per train, including all the above expenses; for example, the latest accounts of the North Union railway show the cost to have been only 3*s.* 4*d.*, not including any funds for reserve. The professor himself thought that 3*s.* was a fair sum, exclusive of taxes and duty, which, however, together form a large proportion of the expense. On the other hand, there were instances in which the expenses had gone up to 5*s.* per mile per train. He considered it would be a great public benefit if all railway companies, in their reports, would give fuller details of the working expenses, and state the number of miles run *by trains*. Some few boards set a very good example in this respect. This was sometimes done for locomotive power, but the miles should only be computed as actually run with the trains, and not to include the various extra distances passed over in manœuvres, piloting, signals, etc., which, though necessary, were not part of the actual mileage of trains.

The Professor then drew the attention of the class to the fact, that the locomotive power formed about one-third of the gross expense, and of that one-half only is likely to be affected by the gradient or load, being only one-sixth of the whole of the working ex-

penses, which was but a small item upon which a saving was to be made, to justify a railway being constructed theoretically perfect, unless the traffic was likely to be continued, regular, and very heavy. He further observed, that though he had proposed, for the sake of an easier comparison, to reduce all the items of the working expenses of a railway to a mileage per train, it was manifest that a considerable addition to the number of trains daily, and, of course, to the number of miles run, would very materially affect the locomotive power only. The taxes would be contingent on the receipts; and all the other items would be increased but in a very small degree, on the annual totals, by an increase in the number of the trains with a carriage or two less at a time. It was important to remember this, as it affected greatly the question of laying out railways. Mr. Vignoles insisted that the extension of railways in England, especially in remote districts, would not be carried into effect until this subject had been more closely analysed, and had become better understood. Looking at the practical working of the Newcastle and Carlisle, the North Union, the Manchester and Leeds, the Sheffield and Manchester, as far as opened, and other lines, all having very heavy gradients, and contrasting their working expenses with those of lines whose inclinations were much more favorable, the average cost per train per mile did not vary greatly. Lines which had been formed at a cost of from £50,000 to £60,000 per mile, a large portion of which was to obtain perfect gradients, seemed to require little less to work them than lines costing only from one-third to one-half that sum. It is true they might be able to carry heavier trains, and did so carry them occaaionally, but the average was very nearly what had been stated, and, besides, the public were best accommodated by lighter trains going more frequently. The Professor said, he could only hope that his arguments would draw attention to the subject, and that when, after the analysis of the cost of all the railways had been brought out in the way shown in his last lecture, and that of the working expenses, as in the present one materials would be obtained for the solution of the problem, of what must be the rule for constructing lines of passenger railways hereafter.

ELECTRO-MAGNETIC RAILWAY LOCOMOTIVE.

A trial of this very ingenious machine, constructed by Mr. Davidson, was made last month on the Edinburgh and Glasgow railway, in presence of a number of gentlemen, many of whom were eminent for their scientific knowledge. The construction of the carriage is the first attempt which has been made in this country to apply the powers of electro-magnetism to railway traffic, and from the success which attended this trial, sanguine hopes may be entertained that the period is not distant when it will either supersede, in many cases, the employment of steam, or lend a powerful aid to this mighty instrument in all the operations in which it is at present

employed. The carriage was impelled along the railway about a mile and a half, and travelled at the rate of upwards of four miles an hour, a rate which might be increased by giving greater power to the batteries, and enlarging the diameter of the wheels. We understand that the carriage was built at the expense of the railway Company, and we cannot but congratulate them in having the discernment to employ Mr. Davidson, a gentleman of much practical knowledge and talent, to whose genius great discoveries have been made in electro-magnetism, by whom the carriage was projected, and to whose unwearied exertions the practicability of the scheme is almost placed beyond a doubt.

The dimensions of the carriage are 16 feet long by 7 feet wide and is propelled by 8 powerful electro-magnets. The carriage is supported by four wheels of 3 feet diameter. On each of the two axles there is a wooden cylinder, on which are fastened three bars of iron at equal distances from each other, and extending from end to end of the cylinder. On each side of the cylinder, and resting on the carriage, there are two powerful electro-magnets. When the first bar on the cylinder has passed the faces of two of these magnets, the current of galvanism is then let on to the other two magnets. They immediately pull the second bar until it comes opposite them. The current is then cut off from these two magnets, and is let on to the other two. Again they pull the third bar until it comes opposite, and so on—the current of galvanism being always cut off from the one pair of magnets when it is let on to the other.

The manner in which the current is cut off and let on is simply thus:—At each end of the axles there is a small wooden cylinder, one-half of which is covered by a hoop of copper; the other is divided alternately with copper and wood (three parts of wood and three of copper.) One end of the coil of wire which surrounds the four electro-magnets, presses on one of these cylinders, on the part which is divided with copper and wood; the other end of the coil presses on the other cylinder in the same manner. One end of the wires or conductors which comes from the battery, presses constantly on the undivided part of the copper on each cylinder. When one of the iron bars on the wooden cylinder has passed the faces of two magnets, the current of galvanism is let on to the other two magnets, by one end of the coil which surrounds the magnets, passing from the wood to the copper, and thereby forming a connexion with the battery. This wire continues to press on the copper until the iron bar has come opposite the faces of the two magnets, which were thus charged with magnetism. On its coming into that position, the current is cut off from these two magnets, by the wire or rod of copper passing from the copper to the wood and thereby breaking the connexion with the battery. But when the wire or rod of copper leaves the copper on the one cylinder, it leaves the wood, and passes to the copper on the other cylinder at the other end of the axle, and in so doing connects the other two magnets with the battery, and they pull the next iron bar in the

same manner. At the other end of the carriage there are other four magnets and wooden cylinder, with iron bars arranged in the same manner.

The battery which is used for propelling the machine is composed of iron and zinc plates immersed in dilute sulphuric acid, the iron plates being fluted so as to expose greater surface in the same space. The weight propelled was about six tons.—*Edinburg Eve. Journal.*

NAVAL EXPERIMENTS ON THE DEFENCES OF STEAM BOILERS.—A highly interesting experiment was tried at Portsmouth last month, on board the Excellent gunnery-ship, Captain Sir Thomas Hastings to test the efficacy of the defences of the boilers in steam-ships of war. One of the greatest difficulties to surmount, in order to render the steam navy of greater efficiency in action, is to afford adequate protection to the boilers against the shot of the enemy, as a ball perforating them would at once place a vessel *hors de combat*. With the view of affording this protection to the boilers, several war steamers have been fitted up with extra defences at the parts where the boilers are fixed. These defences consist of 15 plates or layers of metal, each $\frac{3}{8}$ inch thick. The object of the experiment on board the Excellent was to ascertain what resistance these defences of boilers would offer to a cannonade at point blank distance, which is 400 yards. An iron target was prepared, made exactly of the material which constitutes the protection of the boilers of a steamer, and placed at the distance of 400 yards from the ship, from which guns at different calibre were fired at it. Admirals Sir E. Codrington and Parker, and a great number of naval officers, including those from the Austrian frigate, were present to witness the experiment. The first shot that was fired was an eight-inch hollow shot, and was projected from a 68-pounder, medium gun. It struck the bull's-eye, or centre of the target, and, slightly indenting it to the depth of about 5 in., rebounded therefrom, and was split into several pieces by the concussion. The second shot was a solid 32-pounder, and was fired from a gun of 9 ft. 6 in.; it struck the edge of the target, glanced off, and was split into two pieces. The third shot hit the centre of the target, where it lodged, having penetrated several plates. The fourth shot struck the third, and sent it clean through all parts of the iron, splitting it into numberless pieces, which were found on the off-side of the wooden stage on which the target was fixed. The fifth and sixth shots went through the perforation made by the third and fourth. About 10 other shots were fired, all striking the target in various parts, and completely destroying it. The result of this experiment has shown how totally inadequate are the present defences of the boilers of war steamers to protect them from the assaults of the enemy where a precision of fire had been attained.—*Times.*

THE CROTON WATERWORKS.

In order to understand the real magnitude and value of the Croton Waterworks, our readers may refer to the following article from the New York Commercial Advertiser. The work, as the editor observes, is worthy in its conception and design to form an era in history, from the utility, vastness, and simplicity of the undertaking. For centuries to come, it will stand a noble monument of the enterprise, art, and science of the present generation. No population of three hundred thousand ever before executed such a plan—not undertaken to mark a field of battle—nor, like the vast walls of China, Rome, or of modern Paris, in preparation for defence in war. On the contrary, the Croton aqueduct regards the health, temperance, and happiness of myriads of the present generation, and of ages to come. Annexed is the brief historical and descriptive account, which is full of interest;

"The work was commenced in July, 1835, and the whole amount of expenditure since (Aug. 8), has been $7,606,213 84. Here are some of the principal items;

Aqueducts, reservoirs, bridges etc.	$6,370,587
Salaries of engineers, etc.	503,042
Law expenses	16,133
Real estate purchased	349,932

The whole line is divided into one hundred and one sections, generally half a mile long, and the first is the Croton dam, by which the Croton water is collected. This embankment is 250 feet long, 85 high, and 55 wide at the top, and is made of hydraulic stone masonry. The beautiful sheet of water thus formed has been named the Croton River Lake, to distinguish it from the artificial reservoirs; it covers four hundred acres of land, and will contain six hundred millions of gallons. This will allow a discharge of thirty-five millions of gallons every day, an ample supply for a long time to come. Other dams can increase the quantity if it shall be ever needed.

In the distance of 25 miles through Westchester county are passed an arch bridge of 88 feet, 12 tunnels or excavations under ground for the acqueduct, the aggregate length of which is 4,406 feet; 38 ventilators and four waste-weirs for the discharge of surplus water; and all are finished at an expense of about four millions of dollars. At section 86 the aqueduct crosses the Harlem river; here a bridge is now building for this purpose, which is indeed a Herculean task, requiring more skill and watchfulness than any part of the whole line. It will consist of seven arches over land, and 50 feet span, with eight arches over water of 80 feet span, and when finished will nearly equal in dimensions any bridge in the world. Its cost is estimated at one million of dollars, and its elevation is so great as not to impede the navigation of the stream; thus taking care of posterity and the wants our metropolis when she shall have extended to the Harlem river. Some idea

of this vast undertaking may be formed from the fact that the excavation for one pier has been carried 34 feet below the surface of the water, and then, a rock foundation not having been reached, 240 piles, from 30 to 40 feet long, were driven in for the purpose. Several piers have been already carried, by the aid of coffer dams, from four to fifteen feet above high water mark.

"Nearer the city there are more than 1,200 feet of tunnels cut through rock for two lines of iron pipes, 36 inches in diameter. Section 96 embraces the receiving reservoir at Yorkville—an immense structure, covering a surface of 32 acres, resembling an inland lake, and containing 158 millions of gallons. The walls and embankments are of the most massive and durable construction, and the whole is enclosed by a beautiful iron railing. The next two miles form the connecting link with the distributing reservoir on Murray's hill. This is a beautiful spot, and an admirable piece of workmanship, of solid granite, in form square, but much smaller than the other reservoir. Around its elevated summit, 115 feet above mean tide, and 31 feet above the surface, is a noble and broad walk, affording a most extensive view of the city, the Hudson, and the the surrounding country.

The work south of the distributing reservoir consists in laying pipes to supply the lower part of the city with the water. More than 100 miles have been finished, and 30 more are yet to be added. Splendid public fountains will be built in our principal squares and public places, furnishing a supply of water to the poor, and highly ornamental to the city. Those at Union square and the Park are now in operation; the basin of the latter forms a circle 100 feet in diameter, with a turf bank, and the jets rise to a height of 55 feet. The former has a basin 60 feet in diameter, and three feet deep, with various jets 60 feet high, the most imposing of which presents the form of a wheat sheaf, resembling one in the court of the Palais Royal at Paris. Both fountains are strikingly beautiful, and few in the world are of equal dimensions.

The whole length of the aqueduct is 32 miles; its foundation is stone, and a bed of concrete made from broken granite and hydraulic stone; the sides are of hammered stone, and the floor an inverted arch of brick eight inches thick; the upper arch the same. On the 8th of June last the superintendents went through the aqueduct on foot, and the whole being found complete, on the 22d the water was admitted to the depth of 18 inches. 'The Croton Maid,' a small boat prepared for the purpose, and holding four persons, was then placed in the aqueduct, and navigated its entire length by some of the same party. This novel voyage was made sometimes at a depth of 75 feet below, and then again 80 feet above, the natural surface of the earth, at the rate of a mile in 40 minutes, the velocity of the current. When four feet deep this will probably reach two miles per hour.

On the 27th the water was admitted into the immense receiving reservoir in the presence of a large assemblage, including the Mayor, Governor, Military, Firemen, etc. etc. To this basin the stream

was admitted on the 4th day of July, amidst general and imposing demonstrations of public joy.

Since then the water has continued to flow about two feet deep through the aqueduct, delivering into the receiving reservoir twelve millions of imperial gallons per day, and as yet only five or six millions in the pipes; nor has any defect been found in any section of the work. The Harlem bridge is alone unfinished, and it will require a vigorous prosecution of that work to finish it in two and a half years. In the mean time the temporary pipes used there answer every purpose for the passage of the water. Over twelve millions of dollars is the estimated cost of the entire work when done. From ten to twelve dollars is the rate charged per annum to families for the use of the water; its own force carries the stream into the highest stories of the most elevated buildings. The names of Major Douglass and his successor John B. Jervis, Esq., the engineers, will be connected with the Croton aqueduct as long as it endures. We have heard of the 'seven wonders of the world.' This may justly be considered the eight; and, although last in time, it is amongst the foremost for its magnitude, expense, and public utility."

Astronomical Clock at Strasburg.—An astronomical clock of remarkable ingenuity has lately been constructed at Strasburg by a M. Schwilgue. It is composed of three parts, respectively indicating the time of the day, the day of the month and year, and the movements of the constellations. The central moving power, which is another and very exact timepiece, shows on the face the hour and its subdivisions, strikes the hours and the quarters, and puts in motion several curious allegorical figures. The cock-crow, which had been mute since 1789, has been reproduced, and a procession of the apostles takes place daily at noon. The calendar shows the months, the days, and the dominical letter, as well as the Catholic calendar, showing every Saint's day in the year. The plate or face on which these figures and signs appear makes one revolution in 365 days for the common, and 366 for the bissextile year, always reproducing the irregularity which takes place three times in every four secular years. The moving fasts and feasts are shown by an extremely ingenious process. On the 31st of December, at midnight, Easter day and the other moving feasts for the year appear on the calendar. The third division is the triumph of the artist's skill. A complete orrery after the Copernican system is produced. The movements of all the planets visible to the naked eye are represented. The earth is shown accompanied by her satellite, the moon, which accomplishes her revolution in one month. The different phases of the moon are represented on a different and separate globe. Another globe represents the apparent movement of the heavens, making one revolution in the sideral day. This movement is subjected to that almost imperceptible power, known by the name of the procession of the equinoxes. The mechanism,

besides many other things, shows the apparent movements of the sun and moon with wonderful precision, and for an indefinite period so that the rising and setting of the sun, its passage to the meridian the eclipse of the sun and moon, etc., are all represented on the face of the apparent time in a most ingenious manner.

ELECTRICAL EXPERIMENT.—In the course of experiments instituted by Messrs. Wright and Bain for the improvement of their electrical telegraph, they discovered that the electric circuit of a galvanic battery is as effectually completed through a large body of water as through an insulated wire. They have applied this curious discovery so effectually as to be now able to dispense with two of the wires heretofore thought necessary for the action of their printing telegraph ; and they are thus enabled to print all communications, either verbal or symbolical, at any distance, by the use of a single wire. We understand they are now in treaty with the government to construct a telegraph on this principle between the admiralty and Portsmouth. One insulated wire would be laid down between the two points, to connect the galvanic battery of the outport with the printing apparatus of the Admiralty, and the return current would be sent through the earth in lieu of using a second wire to complete the circuit. Should the moisture in the ground not prove sufficient to conduct the electricity, the inventors propose to transmit the return current by water; making it pass down the Thames to the German Ocean, and thence along the Channel to Portsmouth ; this roundabout voyage to be performed instantaneously. By thus simplifying, and consequently greatly reducing the cost of the electrical printing telegraph, the inventors have gone far towards rendering it generally available ; another step in advance will dispense with all metallic connection whatever.

THE MANUFACTURE OF WATCHES BY MACHINERY.—A gentleman, who has devoted twenty years of his life to the subject, has made a variety of machines by which an incredible number of watches, of every variety of size, may be made in a day. By one of the machines 300 perfect plates can be produced in a day, by another the same quantity of barrels ; by five machines the requisite number of centre, third, and fourth wheels (crossed, polished and cut) with balances for 300 movements. By another 200 pinions can be cut and rounded ; by another the holes are drilled, the tapping, the screw-holes, the various parts in the plate are sunk, planting the depths and escapement, etc., and all with such exactness as cannot be excelled, another for the making and polishing of pivots, etc. Four other machines will be sufficient for making pivots for 50 movements a day ; and to add to these, there are 20 other machines for every description of work connected with the watch making, and which altogether constitute a set. The inventor has submitted these machines to the scrutinizing inspection of the most experienced makers of chronometers and watches in London, and not one has expressed a doubt of the work so produced

being incomparably superior to that done in the usual way. Among other distinguished names in the trade we have observed those of Mr. Barwise, Mr. Earnshaw, Mr. Hewett, Mr. Vieyres, Messrs. Frodsham and Co., with about a hundred watchmakers in the country, who, with the Duke of Hamilton and Mr. Howell, (of the firm of Howell and James,) at their head, are engaged in carrying out the great and national object of restoring this lost and important manufacture to England by means that while they greatly lessen the price, will improve the quality, and entirely undersell our foreign rivals, and be very largely profitable to all parties concerned.

Dredge's Suspension Bridge.—A new iron suspension bridge on Mr. Dredge's principle has just been completed, at Wraybury, in Buckinghamshire, about 20 miles west of London. It is stated to be a very light and powerful structure, and is not half so expensive as is the timber centreing for a common stone bridge of the same magnitude. It is 17 ft. wide, 100 ft. span, and is intended for every description of traffic. It is perfectly level from end to end. It was completed in three weeks after the foundation stone was laid.

Caoutchouc Cement.—M. Valle, a color maker, observing the injury caused to the works of some of the greatest masters by the influence of the atmosphere upon the canvass, has invented a solution (said to be of caoutchouc) which, although applied to both sides of the canvass, leaves it sufficiently elastic to prevent cracking, and secures it against the action of the atmosphere. To this he adds a peculiar kind of varnish for the painting, which is said to defy the ravages of time.

Mr. Jeffrey's Cement.—Some further experiments have been made in the marshes at Woolwich. A block of wood submitted by Mr. Jeffrey was bored to the centre, exactly in the middle of the joining, and a 5½ inch shell inserted, for the purpose of tearing it to pieces. On a port-fire being ignited, the shell soon exploded, tearing the solid wood in all directions, and into numerous fragments, but in no part separating the pieces where the joining with the cement was made.

The Galvano-plastic Process.—A proposition has been made by M. Corney to employ this process after embalmment, for the preservation of the human body after death. The idea, however extravagant it may appear, is said not to be original, and that beautiful specimens are to be seen of small animals, birds, insects, etc., which have been thus preserved by M. Soyez, of the Place Vendome.

A German paper states that a proposition has been made to the Porte for the construction of a railroad from Constantinople to Adrianople, and that it was well received. The ground, however, between the two places is so difficult, that the work, if undertaken at all, will be one of great time and expense.